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UNION CARBIDE NUCLEAR COMPANY • DIVISION OF



CORPORATION

POST OFFICE BOX P, OAK RIDGE, TENNESSEE

April 27, 1960

7234

ENVIRONMENTAL LEVELS OF RADIOACTIVITY

Report for First Quarter, 1960

Data Compiled by:

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Introduction

This report is based on a continuation of the monitoring program described in "Environmental Levels of Radioactivity, Report for 1959", dated April 27, 1960. The method and techniques which were described in the previous report have been used in the preparation of this information.

OAK RIDGE NATIONAL LABORATORY (X-10)

Discussion of Data

Data on the environmental levels of radioactivity for the first quarter of 1960 in the Oak Ridge and surrounding areas are presented in Tables I through VIII.

The air contamination level shown by the continuous air monitoring filter data for the immediate and remote environs of the plant was 0.11% of the maximum permissible concentration for populations in the neighborhood of a controlled area. There were no large fluctuations in the levels measured during the period and levels did not vary significantly from background levels measured by the U. S. Public Health Service in other areas of the United States.

The probable average concentrations of radioactivity in the Clinch River at Mile 20.8, the point of entry of the wastes, and at Mile 4.5, near Kingston, Tennessee, were 10.3×10^{-7} $\mu\text{c/cc}$ and 7.8×10^{-7} $\mu\text{c/cc}$ respectively. These values are 26.9% and 16.4% of the weighted average maximum permissible concentration as recommended by the National Committee on Radiation Protection. The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 8×10^{-11} $\mu\text{c/cc}$ which is 0.002% of the weighted average (MPC)_w value.

External gamma radiation in the Oak Ridge area averaged 0.017 mr/hr. This level does not differ significantly from the average of the levels measured throughout the United States by the Public Health Service Radiation Surveillance Network.

TABLE I

CONTINUOUS AIR MONITORING FILTER DATA

Units of 10^{-13} $\mu\text{c}/\text{cc}$ First Quarter 1960

Station Number	Location	Number of Samples Taken	Maximum	Minimum	Average	% of (MPC) _a *
Perimeter Stations						
HP-11	Kerr Hollow Gate	13	1.54	0.56	1.13	0.11
HP-12	Midway Gate	13	1.36	0.59	0.98	0.10
HP-13	Gallaher Gate	13	1.66	0.63	1.06	0.11
HP-14	White Wing Gate	13	1.34	0.45	0.90	0.09
HP-15	Blair Gate	13	2.99	0.48	1.31	0.13
HP-16	Turnpike Gate	13	1.67	0.24	0.99	0.10
HP-17	Hickory Creek Bend	13	1.83	0.29	1.21	0.12
Average					1.08	0.11
Remote Stations						
HP-19	Norris Dam	13	1.95	0.50	1.24	0.12
HP-20	Loudoun Dam	13	2.69	0.18	1.17	0.12
HP-21	Douglas Dam	13	1.86	0.66	1.07	0.11
HP-22	Cherokee Dam	13	2.03	0.54	1.32	0.13
HP-23	Watts Bar Dam	13	2.73	0.37	1.25	0.13
HP-24	Great Falls Dam	13	1.92	0.59	1.19	0.12
HP-25	Dale Hollow Dam	13	1.71	0.34	1.09	0.11
HP-26	Berea, Kentucky	13	1.64	0.12	0.80	0.08
Average					1.14	0.11

* (MPC)_a is taken to be 10^{-10} $\mu\text{c}/\text{cc}$ as recommended in NBS Handbook 69, Table 4, p. 94.

TABLE II

CONTINUOUS AIR MONITORING FILTER DATA

Particles/1000 cu. ft. of Air Sampled

First Quarter 1960

Station Number	Location	Number of Samples Taken	Maximum	Minimum	Average
Perimeter Stations					
HP-11	Kerr Hollow Gate	13	0.22	0.00	0.05
HP-12	Midway Gate	13	0.16	0.00	0.03
HP-13	Gallaher Gate	13	0.12	0.00	0.02
HP-14	White Wing Gate	13	0.16	0.00	0.03
HP-15	Blair Gate	13	0.50	0.00	0.08
HP-16	Turnpike Gate	13	0.19	0.00	0.03
HP-17	Hickory Creek Bend	13	0.23	0.00	0.02
Average					0.04
Remote Stations					
HP-19	Norris Dam	13	0.38	0.00	0.04
HP-20	Loudoun Dam	13	0.22	0.00	0.02
HP-21	Douglas Dam	13	0.16	0.00	0.03
HP-22	Cherokee Dam	13	0.40	0.00	0.06
HP-23	Watts Bar Dam	13	0.13	0.00	0.02
HP-24	Great Falls Dam	13	0.20	0.00	0.04
HP-25	Dale Hollow Dam	13	0.36	0.00	0.05
HP-26	Berea, Kentucky	13	0.20	0.00	0.03
Average					0.04

TABLE III

GUMMED PAPER FALL-OUT DATA

Units of 10^{-4} $\mu\text{c/sq. ft.}$ First Quarter 1960

Station Number	Location	Number of Samples Taken	Maximum	Minimum	Average
Perimeter Stations					
HP-11	Kerr Hollow Gate	13	2.99	0.23	0.95
HP-12	Midway Gate	13	3.31	0.15	0.97
HP-13	Gallaher Gate	13	2.11	0.17	0.71
HP-14	White Wing Gate	13	3.14	0.15	0.73
HP-15	Blair Gate	13	3.45	0.14	1.30
HP-16	Turnpike Gate	13	2.68	0.36	0.95
HP-17	Hickory Creek Bend	13	2.93	0.06	0.67
Average					0.90
Remote Stations					
HP-19	Norris Dam	12	2.39	0.04	0.64
HP-20	Loudoun Dam	13	3.03	0.05	0.65
HP-21	Douglas Dam	13	2.70	0.11	0.63
HP-22	Cherokee Dam	13	2.90	0.08	0.57
HP-23	Watts Bar Dam	13	3.38	0.02	0.65
HP-24	Great Falls Dam	13	3.04	0.03	0.70
HP-25	Dale Hollow Dam	13	1.65	0.05	0.59
HP-26	Berea, Kentucky	13	1.54	0.16	0.51
Average					0.62

TABLE IV

GUMMED PAPER FALL-OUT DATA

Particles/sq. ft.

First Quarter 1960

Station Number	Location	Number of Samples Taken	Maximum	Minimum	Average
Perimeter Stations					
HP-11	Kerr Hollow Gate	13	118.00	0.00	13.92
HP-12	Midway Gate	13	83.00	0.00	11.23
HP-13	Gallaher Gate	13	109.00	0.00	13.46
HP-14	White Wing Gate	13	114.00	0.00	13.31
HP-15	Blair Gate	13	80.00	0.00	10.77
HP-16	Turnpike Gate	13	117.00	0.00	14.15
HP-17	Hickory Creek Bend	13	116.00	0.00	14.15
Average					13.00
Remote Stations					
HP-19	Norris Dam	13	121.00	0.00	13.38
HP-20	Loudoun Dam	13	104.00	0.00	12.77
HP-21	Douglas Dam	13	105.00	0.00	14.08
HP-22	Cherokee Dam	13	62.00	0.00	7.46
HP-23	Watts Bar Dam	13	110.00	0.00	12.69
HP-24	Great Falls Dam	13	63.00	0.00	7.85
HP-25	Dale Hollow Dam	13	80.00	0.00	9.69
HP-26	Berea, Kentucky	13	46.00	0.00	5.82
Average					10.47

TABLE V

RADIOACTIVITY IN RAIN WATER

Units of 10^{-7} $\mu\text{c/cc}$ First Quarter 1960

Station Number	Location	Number of Samples Taken	Maximum	Minimum	Average
Perimeter Stations					
HP-11	Kerr Hollow Gate	11	2.95	0.10	0.54
HP-12	Midway Gate	11	1.54	0.15	0.56
HP-13	Gallaher Gate	11	0.94	0.07	0.44
HP-14	White Wing Gate	11	0.85	0.01	0.30
HP-15	Blair Gate	11	0.90	0.22	0.43
HP-16	Turnpike Gate	11	0.88	0.13	0.53
HP-17	Hickory Creek Bend	11	1.35	0.13	0.48
Average					0.47
Remote Stations					
HP-19	Norris Dam	11	3.73	0.00	0.71
HP-20	Loudoun Dam	11	1.37	0.04	0.53
HP-21	Douglas Dam	11	1.29	0.16	0.60
HP-22	Cherokee Dam	11	1.48	0.13	0.46
HP-23	Watts Bar Dam	11	1.68	0.18	0.58
HP-24	Great Falls Dam	11	2.09	0.20	0.83
HP-25	Dale Hollow Dam	12	1.01	0.23	0.52
HP-26	Berea, Kentucky	12	5.77	0.07	0.99
Average					0.65

TABLE VI

PROBABLE AVERAGE CONCENTRATION OF RADIOACTIVITY
IN THE CLINCH RIVER AT MILE 20.8

Units of 10^{-7} $\mu\text{c/cc}$

First Quarter 1960

Number of Samples Taken	Maximum	Minimum	Average	% of $(\text{MPC})_w$
91	21.3	3.3	10.3	26.9

TABLE VII

AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
IN THE CLINCH RIVER

First Quarter 1960

Location	Sampling Period	Units of 10 ⁻⁸ µc/cc				Co ⁶⁰	Probable Avg. Concn. of Radioactivity µc/cc x 10 ⁻⁸	(MPC) ^a _w 10 ⁻⁶ µc/cc	% of MPC
		Sr90	Ce144	Cs137	Ru103-106				
Clinch River									
Co Mi. 37.5	10/1/59 - 1/29/60	0.11	0.10	*	*	*	0.45	0.21	2.14
Mi. 20.8 ^b	12/28/59 - 3/27/60	0.67	1.62	1.48	44.75	3.45	103.2	3.83	26.9
Mi. 4.5	11/4/59 - 1/27/60	0.91	0.36	0.41	69.68	0.86	77.5	4.72	16.4

^a Weighted average (MPC)_w calculated for the mixture using (MPC)_w values for specific radionuclides recommended in the NBS Handbook 69.

^b Values given for this location are calculated values based on the levels of waste released and the dilution afforded by the river.

* None detected.

TABLE VIII

EXTERNAL GAMMA RADIATION LEVELS

mr/hr

First Quarter 1960

Station Number	Location	January	February	March	Average
1	Solway Gate	.018	None taken	.015	.017
2	Y-12 East Portal	.018	"	.012	.015
3	Newcomb Road Oak Ridge	.015	"	.013	.014
4	Gallaher Gate	.025	"	.018	.022
5	White Wing Gate	.019	"	.014	.017
Average					.017

OAK RIDGE GASEOUS DIFFUSION PLANT (K-25)

The results of environmental sampling by the ORGDP during the first quarter of 1960 indicate little, if any, radioactive material contamination of air, soil, or water either inside the plant boundaries or in the plant environs. In all cases, values measured were only small fractions of the recommended maximum permissible concentrations.

With respect to air-borne contamination, monitoring of the general air well within plant boundaries (averaging about 225 eight-hour samples per quarter) revealed no indication of activities approaching the permissible limits (general population) within these boundaries for even short periods. Thus, it appears essentially impossible that any significant air contamination problems can occur outside the ORGDP area.

Plant wastes released into public waterways are monitored at least weekly to insure that the concentration of these materials in the streams leaving the plant boundaries does not exceed the permissible limits given in NBS Handbook No. 69 for drinking water for population in the neighborhood of a controlled area. Monitoring points in Poplar Creek and Clinch River are both upstream and downstream from ORGDP. There were no instances of water release at the plant boundaries above the long-term maximum permissible concentration even for as short a time as the weekly sampling period, and the average activity in Poplar Creek below the plant for the quarter continues to represent only 0.02% of the maximum permissible concentration for the discharge of natural uranium; the levels in the Clinch River were much less than this figure.

ENVIRONMENTAL SAMPLING
OAK RIDGE GASEOUS DIFFUSION PLANT

First Quarter, 1960

Location of Point	Type of Analysis Made	No. of Samples	Concentration ($\mu\text{c/cc} \times 10^{-8}$)				Av. Pl. Exp./MPC
			Plant Experience		Max. Permissible (MPC)		
			Low	High		Av.	
<u>Local Streams (Water)</u>							
<u>Poplar Creek</u>	Uranium Concentration						
Upstream		13	1.6	7.0	4.4	2000	0.22%
Downstream	"	13	0.2	1.0	0.5	2000	0.02%
<u>Clinch River</u>							
Upstream	"	13	0	0.3	0.1	2000	0.005%
Downstream	"	13	0.07	0.5	0.2	2000	0.010%
<u>Poplar Creek</u>	Total Beta Activity						
Upstream		13	7.7	226.4	35.6	2000	1.8%
Downstream	"	13	27.9	129.2	74.7	2000	3.5%
<u>Clinch River</u>							
Upstream	"	13	97.7	287.1	171.0	310*	55.0%
Downstream	"	13	32.0	380.7	139.1	310*	45.0%

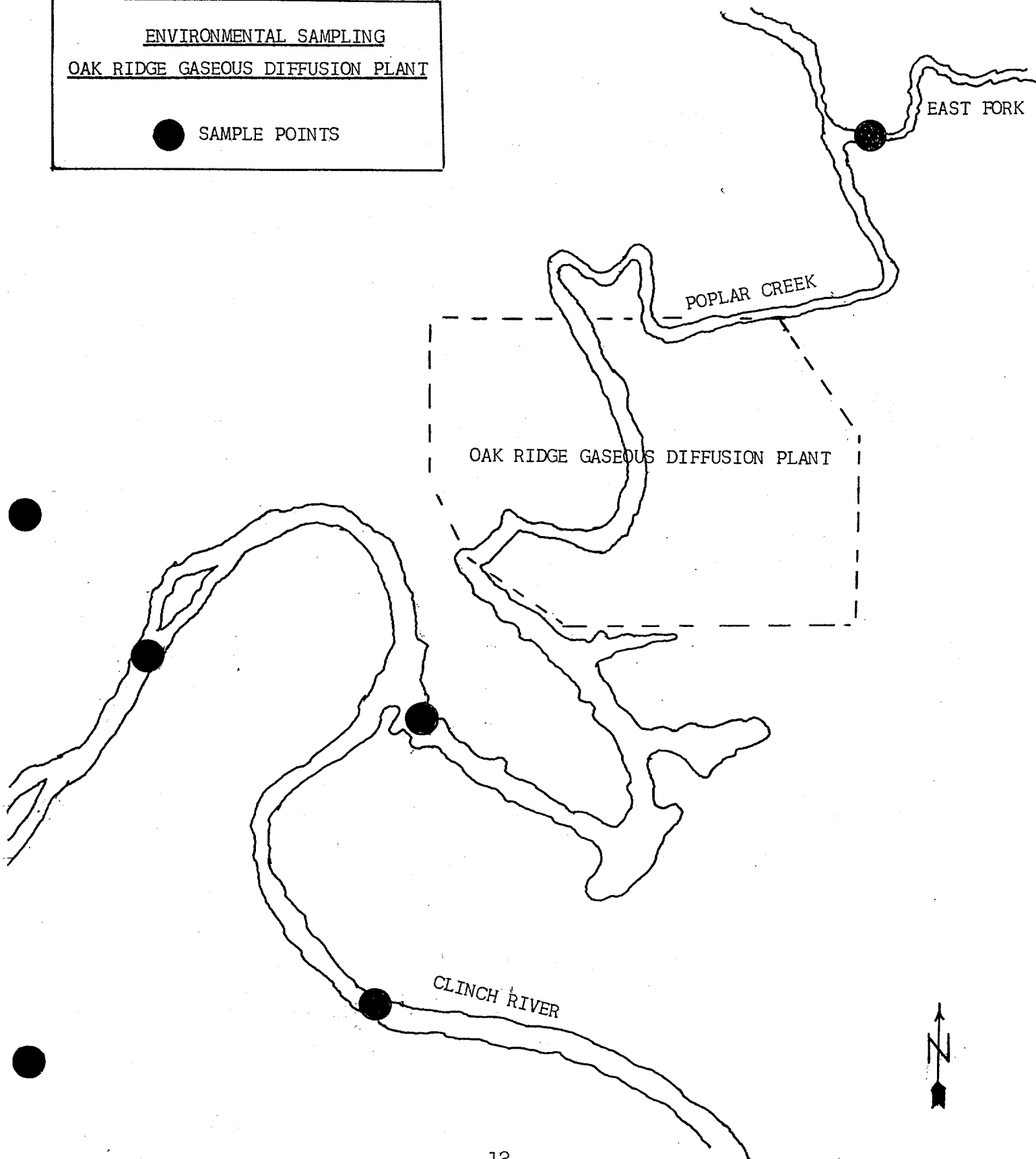
Normal Sampling Frequency: Continuous sampling; composited over one week.

* Measured mixture of radionuclides.

April 18, 1960

ENVIRONMENTAL SAMPLING
OAK RIDGE GASEOUS DIFFUSION PLANT

● SAMPLE POINTS



Y-12 PLANT

The Y-12 Plant does not monitor the air and water outside the plant area. However, in-plant monitoring indicates that the plant levels are well below the limits for environmental levels.

August 24, 1960

ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

Report for Second Quarter, 1960

Data compiled by: H. H. Abee

A-8830

Introduction

This report is based on a continuation of the monitoring program described in "Environmental Levels of Radioactivity for the Oak Ridge Area, Report for 1959", dated May 28, 1960. The methods and techniques which were described in the previous report have been used in the preparation of this information.

Discussion of Data

Data on the environmental levels of radioactivity for the second quarter of 1960 in the Oak Ridge and surrounding areas are presented in Tables I through V.

The air contamination levels for gross β activity shown by the continuous air monitoring filter data for the immediate and remote environs of the plants was 0.16% and 0.17% respectively of the maximum permissible concentration for populations in the neighborhood of a controlled area. Fluctuations in the levels measured during the period were normal and levels did not vary significantly from those measured in other areas of the United States and reported by the U. S. Public Health Service Radiation Surveillance Network.

The probable average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most waste materials, and at Mile 4.5, near Kingston, Tennessee, were 5.6×10^{-7} $\mu\text{c/cc}$ and 1.2×10^{-7} $\mu\text{c/cc}$ respectively. These values are 23.2% and 7.9 % of the weighted average maximum permissible concentration as recommended by the National Committee on Radiation Protection. The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 2.8×10^{-11} $\mu\text{c/cc}$ which is 0.001% of the weighted average $(\text{MPC})_w$ value.

The average activity in Poplar Creek below the ORGDP for the quarter represents only 0.03% of the maximum permissible concentration for natural uranium.

External gamma radiation in the Oak Ridge area averaged 0.014 mr/hr and in the ORGDP area averaged 0.020 mr/hr. These levels do not differ significantly from the average of the levels measured throughout the United States by the Public Health Service Radiation Surveillance Network.

Table I

CONTINUOUS AIR MONITORING FILTER DATA

Units of 10^{-13} $\mu\text{c}/\text{cc}$ Second Quarter 1960

Station Number	Location	Number of Samples Taken	Maximum	Minimum	Average	% of (MPC) _a *
Perimeter Stations						
HP-11	Kerr Hollow Gate	13	2.04	0.94	1.49	0.15
HP-12	Midway Gate	13	4.22	0.64	1.95	0.20
HP-13	Gallaher Gate	13	2.17	0.77	1.41	0.14
HP-14	White Wing Gate	13	1.72	0.28	1.04	0.10
HP-15	Blair Gate	13	3.74	1.38	2.42	0.24
HP-16	Turnpike Gate	12	1.95	0.44	1.30	0.13
HP-17	Hickory Creek Bend	13	2.52	0.21	1.72	0.17
Average					1.63	0.16
Remote Stations						
HP-19	Norris Dam	13	2.96	0.87	1.77	0.18
HP-20	Loudoun Dam	13	3.11	0.94	1.91	0.19
HP-21	Douglas Dam	13	2.61	0.86	1.58	0.16
HP-22	Cherokee Dam	13	2.03	0.76	1.54	0.15
HP-23	Watts Bar Dam	13	2.29	1.05	1.73	0.17
HP-24	Great Falls Dam	13	2.44	0.95	1.89	0.19
HP-25	Dale Hollow Dam	13	2.01	0.64	1.60	0.16
HP-26	Berea, Kentucky	10	1.45	0.08	0.93	0.09
Average					1.65	0.17

* (MPC)_a is taken to be 10^{-10} $\mu\text{c}/\text{cc}$ as recommended in NBS Handbook 69, Table 4, p. 94.

TABLE II

PROBABLE AVERAGE CONCENTRATION OF RADIOACTIVITY
IN THE CLINCH RIVER AT MILE 20.8Units of 10^{-7} $\mu\text{c/cc}$ Second Quarter 1960

Number of Samples Taken	Maximum	Minimum	Average	% of (MPC) _w
83	22.77	0.19	5.6	23.2

TABLE III

AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
IN THE CLINCH RIVERUnits of 10^{-8} $\mu\text{c}/\text{cc}$ Second Quarter 1960

Location	Sr ⁹⁰	Ce ¹⁴⁴	Cs ¹³⁷	Ru ¹⁰³⁻¹⁰⁶	Co ⁶⁰	Probable Average Concentration of Radioactivity	(MPC) _w ^a	% of MPC
Mi. 37.5	.10	.05				.3	29	1
Mi. 20.8 ^b	.8	.2	.4	16.3	1.2	56.2	243	23.2
Mi. 4.5	.7	.09	.06	9.1	.05	11.8	149	7.9

^a Weighted average (MPC)_w calculated for the mixture using (MPC)_w values for specific radionuclides recommended in the NBS Handbook 69.

^b Values given for this location are calculated values based on the levels of waste released and the dilution afforded by the river.

TABLE IV

CONCENTRATION OF RADIOACTIVITY IN POPLAR CREEK

Second Quarter 1960

Location of Point	Type of Analysis Made	No. of Samples	Units of 10^{-8} $\mu\text{c/cc}$			Percent (MPC)
			Maximum	Minimum	Average	
Upstream (East Fork)	Uranium Concentration	13	13.0	2.4	5.7	0.29
Downstream (Outfall)	"	13	1.3	0.4	0.6	0.03
Upstream (East Fork)	Total Beta Activity	13	21.2	2.7	7.1	0.36
Downstream (Outfall)	"	13	171.5	5.4	39.9	2.00

Normal Sampling Frequency: Continuous sampling; composited over one week.

TABLE IV

EXTERNAL GAMMA RADIATION LEVELS

mr/hr

Second Quarter 1960

Station Number	Location	April	May	June	Average
1	Solway Gate	*	.014	.014	.014
2	Y-12 East Portal	*	.014	.013	.014
3	Newcomb Road, Oak Ridge	*	.014	*	.014
4	Gallaher Gate	*	.014	.013	.014
5	White Wing Gate	*	.016	.013	.014
Average					.014
* None taken					

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November 14, 1960

ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

Report for Third Quarter 1960

Data Compiled by: H. H. Abee

DEC 7- 1960

Δ - 11902

Introduction

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are released to pits located in the Conasauga shale formation. Low level liquid wastes are discharged, after preliminary treatment, to the surface streams.

Air that may become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by means of filters, scrubbers, and/or precipitators.

This report presents data on the environmental levels of radioactivity for the Oak Ridge Area and compares the data with established maximum permissible concentrations.

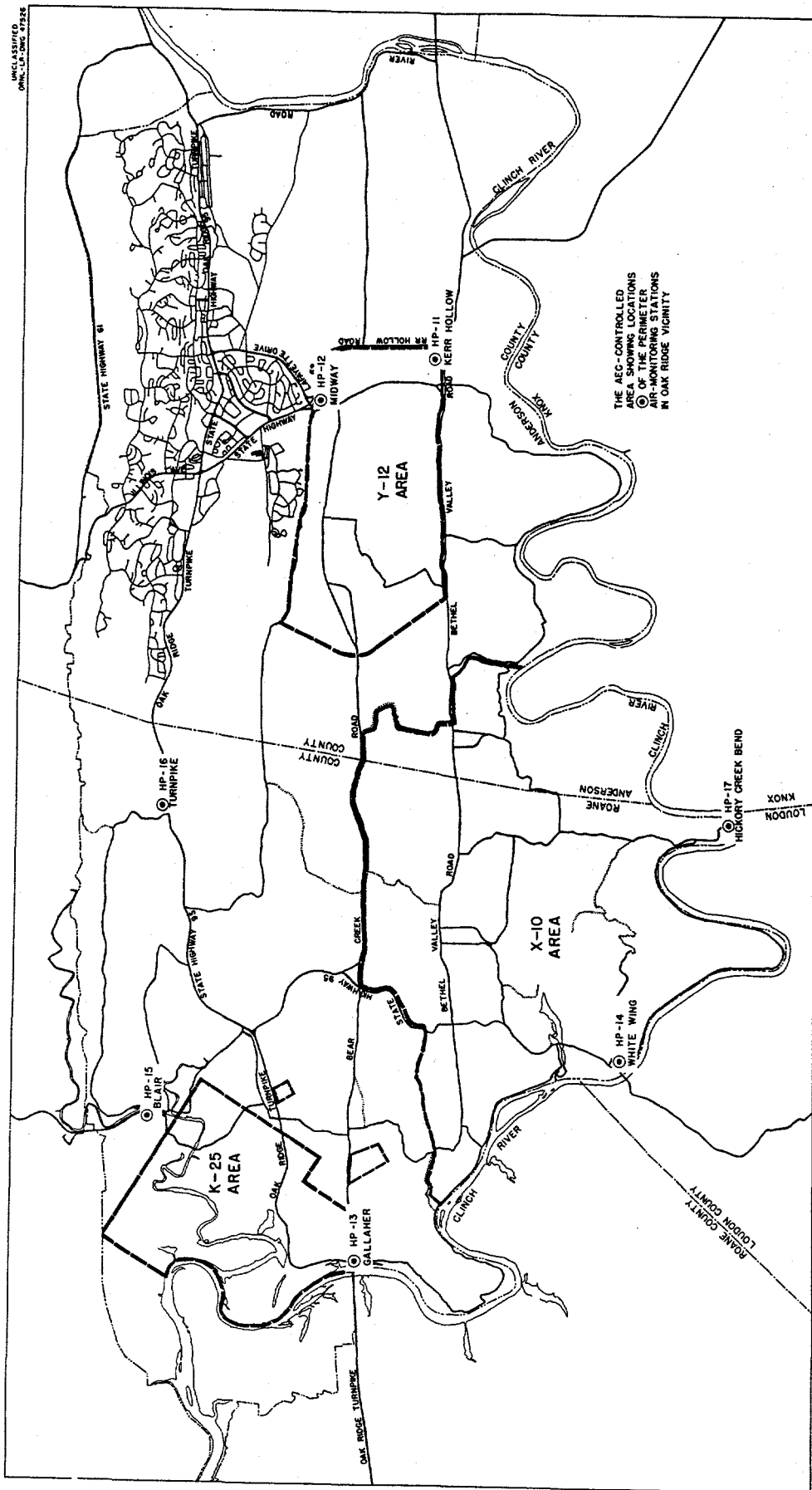
Air Monitoring

Atmospheric contamination and fall-out occurring in the general environment of East Tennessee are monitored by two systems of monitoring stations. One system consists of seven stations which encircle the plant areas (Fig. 1) and provides data for evaluating the impact of all Oak Ridge operations on the immediate environment. A second system consists of eight stations encircling the Oak Ridge Area at distances of from 12 to 120 miles (Fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur.

Sampling is carried out by passing air continuously through a filter paper. The filter paper will collect those particulates considered to be respirable. Data collected are accumulated and tabulated in average $\mu\text{c/cc}$ of air sampled.

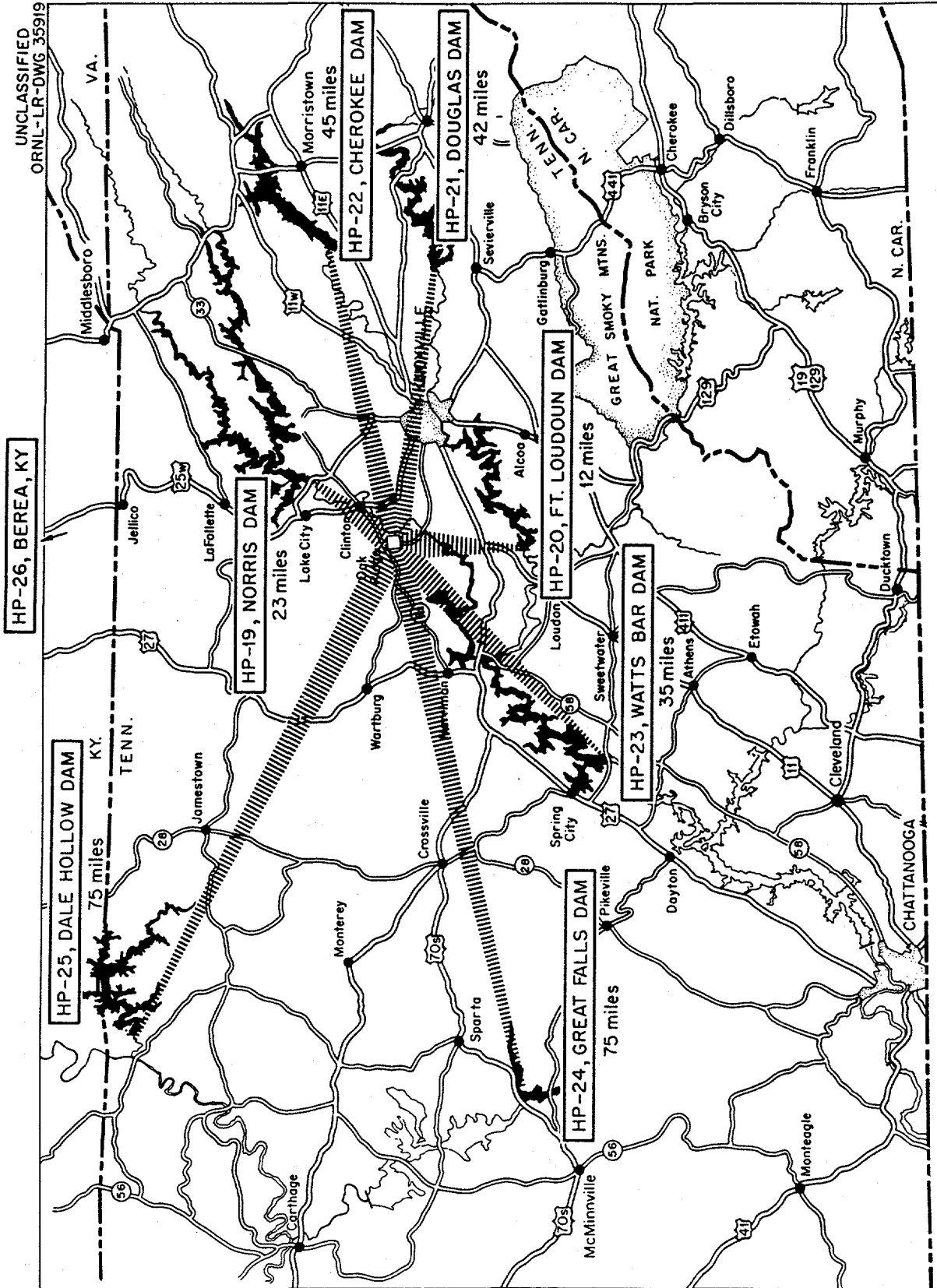
Water Monitoring

Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, into the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River.



STATION SITES FOR PERIMETER AIR MONITORING SYSTEM

Figure 1



STATION SITES FOR REMOTE AIR MONITORING SYSTEM

Figure 2

Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for populations in the neighborhood of a controlled area as recommended by the National Committee on Radiation Protection (NCRP). The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 3 and 4. Samples are taken in Poplar Creek and White Oak Creek prior to entry of the wastes into the public waterway and at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously by the United States Geological Survey to obtain dilution factors for calculating the probable concentrations of wastes in the river.

The fraction of the total beta activity comprised by each isotope is determined from analysis of long-lived radionuclides contained in the effluent and a weighted average maximum permissible concentration for water, $(MPC)_w$, for the mixture of radionuclides is calculated on the basis of the isotopic distribution using the MPC values of each isotope as recommended by the NCRP. The average concentrations of radioactivity in the Clinch River are compared to the calculated $(MPC)_w$ value.

Gamma Measurements

External gamma radiation levels are measured monthly at five locations in the Oak Ridge Area. Measurements are taken with a Geiger-Muller tube at a distance of three feet above ground and the results are tabulated in terms of mr/hr.

Discussion of Data

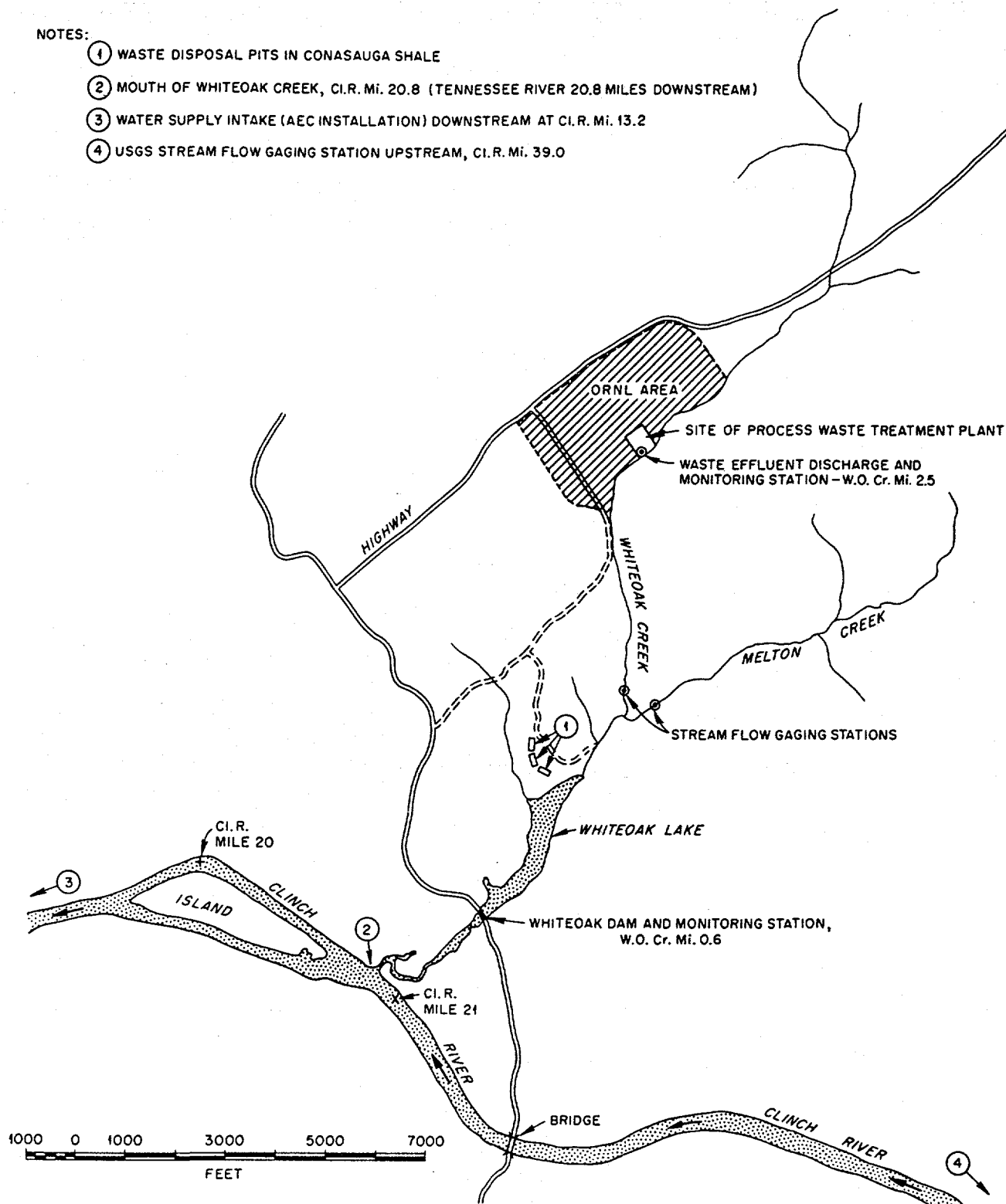
Data on the environmental levels of radioactivity for the third quarter of 1960 in the Oak Ridge and surrounding areas are presented in Table I through Table V.

The air contamination levels for gross β activity as shown by the continuous air monitoring filter data for the immediate and remote environs of the plants were 0.09% and 0.08% respectively of the maximum permissible concentration for populations in the neighborhood of a controlled area. The levels measured during this period were not significantly different from those measured in other areas of the United States and reported by the U. S. Public Health Service Radiation Surveillance Network.

The calculated average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most waste materials, and at Mile 4.5, near Kingston, Tennessee, were 2.2×10^{-7} $\mu\text{c/cc}$ and 1.2×10^{-7} $\mu\text{c/cc}$ respectively. These values are 12.6% and 4.9% of the weighted average maximum permissible concentration as recommended by the National Committee

NOTES:

- ① WASTE DISPOSAL PITS IN CONASAUGA SHALE
- ② MOUTH OF WHITEOAK CREEK, C.I.R. MI. 20.8 (TENNESSEE RIVER 20.8 MILES DOWNSTREAM)
- ③ WATER SUPPLY INTAKE (AEC INSTALLATION) DOWNSTREAM AT C.I.R. MI. 13.2
- ④ USGS STREAM FLOW GAGING STATION UPSTREAM, C.I.R. MI. 39.0



Location Sketch Map
ORNL Area Surface Drainage

Figure 3

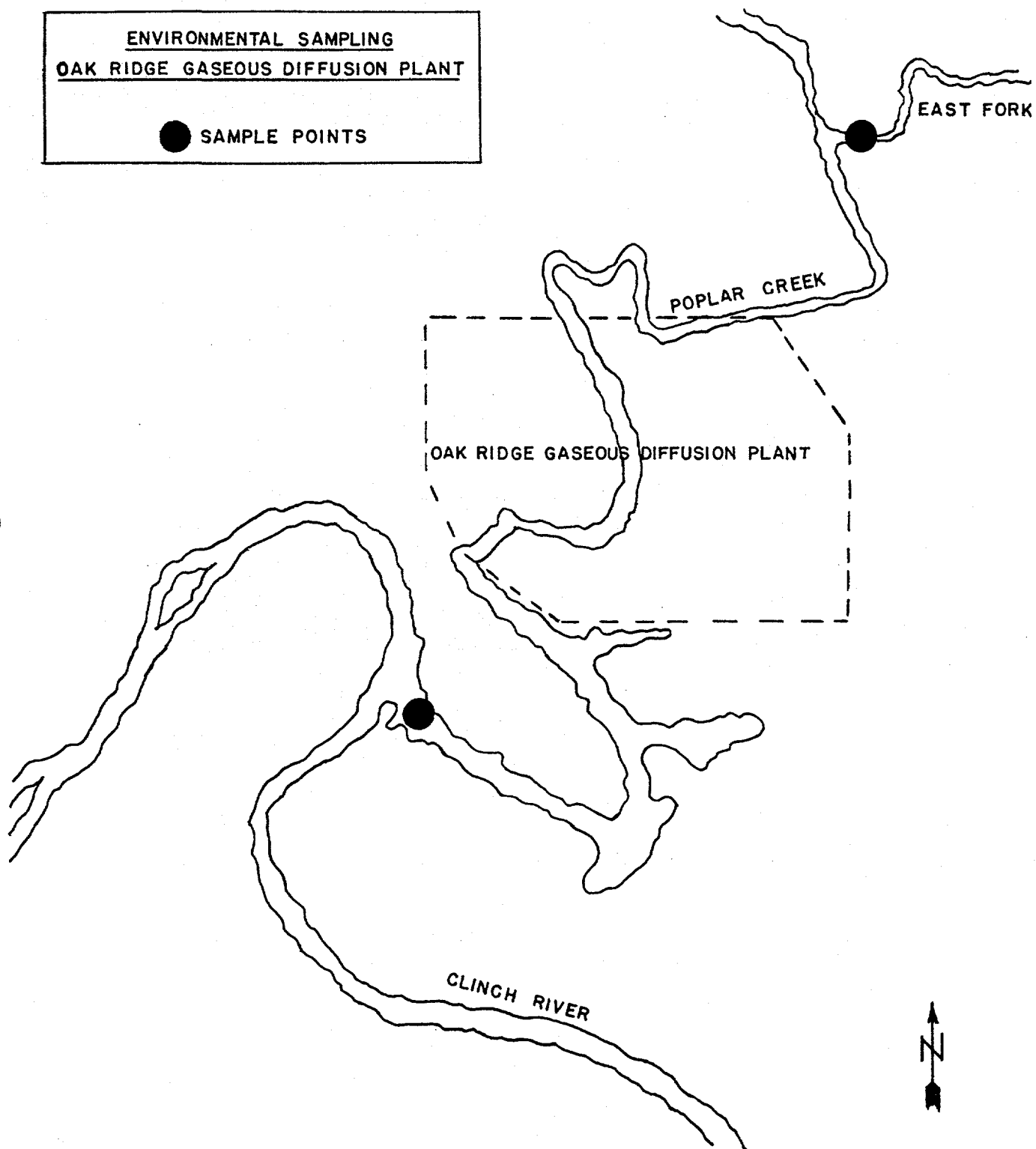


Figure 4

on Radiation Protection. The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 1.9×10^{-11} $\mu\text{c/cc}$ which is 0.001% of the weighted average $(\text{MPC})_w$ value.

The average activity in Poplar Creek below the ORGDP for the quarter represents only 0.04% of the maximum permissible concentration for natural uranium.

External gamma radiation in the Oak Ridge Area averaged 0.015 mr/hr. This level is not significantly different from the average of the levels measured throughout the United States by the U. S. Public Health Service Radiation Surveillance Network.

Conclusion

From the data presented, it seems evident that the Oak Ridge Operations are contributing little to the air or ground contamination in the neighborhood of the area controlled by the Atomic Energy Commission.

Some radioactivity has been contributed to the Clinch River by the release of radioactive liquid wastes, but concentrations of radioactivity in the river are well below the maximum permissible concentration recommended by the NCRP for populations living in the vicinity of an atomic energy installation.

TABLE I

CONTINUOUS AIR MONITORING FILTER DATA

Units of 10^{-13} $\mu\text{c}/\text{cc}$ Third Quarter 1960

Station Number	Location	Number of Samples Taken	Maximum	Minimum	Average	% of (MPC) _a *
Perimeter Stations						
HP-11	Kerr Hollow Gate	14	2.86	0.34	1.03	0.10
HP-12	Midway Gate	14	2.81	0.08	0.99	0.10
HP-13	Gallaher Gate	14	1.11	0.20	0.60	0.06
HP-14	White Wing Gate	14	0.94	0.07	0.66	0.07
HP-15	Blair Gate	14	1.94	0.43	1.11	0.11
HP-16	Turnpike Gate	14	1.24	0.46	0.78	0.08
HP-17	Hickory Creek Bend	14	1.40	0.20	0.78	0.08
Average					0.85	0.09
Remote Stations						
HP-19	Norris Dam	13	1.41	0.35	0.82	0.08
HP-20	Loudoun Dam	13	1.58	0.49	0.87	0.09
HP-21	Douglas Dam	13	1.38	0.16	0.80	0.08
HP-22	Cherokee Dam	13	1.22	0.19	0.72	0.07
HP-23	Watts Bar Dam	13	1.34	0.54	0.88	0.09
HP-24	Great Falls Dam	13	2.39	0.41	0.97	0.10
HP-25	Dale Hollow Dam	11	1.12	0.29	0.66	0.07
HP-26	Berea, Kentucky	12	1.24	0.23	0.62	0.06
Average					0.80	0.08

* (MPC)_a is taken to be 10^{-10} $\mu\text{c}/\text{cc}$ as recommended in NBS Handbook 69, Table 4, p. 94.

TABLE II

CALCULATED AVERAGE CONCENTRATION OF RADIOACTIVITY
IN THE CLINCH RIVER AT MILE 20.8Units of 10^{-7} $\mu\text{c/cc}$ Third Quarter 1960

Number of Samples Taken	Maximum	Minimum	Average	% of $(\text{MPC})_w$
91	10.20	0.09	2.15	12.6

TABLE III

AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
IN THE CLINCH RIVERUnits of 10^{-8} $\mu\text{c/cc}$ Third Quarter 1960

Location	Sr^{90}	Ce^{144}	Cs^{137}	$\text{Ru}^{103-106}$	Co^{60}	Calculated Average Concentration of Gross Beta Activity	$(\text{MPC})_w^a$	% of MPC
Mi. 37.5	0.1	0.06	*	*	*	0.1	15	0.7
Mi. 20.8 ^b	0.7	0.1	0.5	6.8	0.6	21.5	171	12.6
Mi. 4.5	0.5	0.06	0.09	3.2	0.2	11.8	242	4.9

^a Weighted average $(\text{MPC})_w$ calculated for the mixture using $(\text{MPC})_w$ values for specific radionuclides recommended in the NBS Handbook 69.

^b Values given for this location are calculated values based on levels of waste released and the dilution afforded by the river.

* None detected.

TABLE IV

CONCENTRATION OF RADIOACTIVITY IN POPLAR CREEK

Third Quarter 1960

Location of Point	Type of Analysis Made	No. of Samples	Units of 10^{-8} $\mu\text{C}/\text{cc}$			Percent (MPC) _w
			Maximum	Minimum	Average	
Upstream (East Fork)	Uranium Concentration	13	11.8	0.14	1.85	0.09
Downstream (Outfall)	"	13	4.9	0.21	0.86	0.04
Upstream (East Fork)	Total Beta Activity	13	22.0	0	6.5	0.33
Downstream (Outfall)	"	13	63.0	0	19.0	0.95

Normal Sampling Frequency: Continuous sampling; composited over one week.

TABLE V

EXTERNAL GAMMA RADIATION LEVELS

mr/hr

Third Quarter 1960

Station Number	Location	July	August	September	Average
1	Solway Gate	0.015	0.014	0.014	0.014
2	Y-12 East Portal	0.014	0.015	0.011	0.013
3	Newcomb Road, Oak Ridge	0.014	0.015	0.013	0.014
4	Gallaher Gate	0.015	0.014	0.017	0.015
5	White Wing Gate	0.016	0.017	0.017	0.017
Average					0.015

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March 14, 1961

ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

Report for Fourth Quarter 1960

Data Compiled by: --H. H. Abbe--

APPROVAL FOR RELEASE

Document: # Unnumbered; Date 3/14/61;

Title/Subject ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA, REPORT FOR FOURTH QUARTER
1960

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Introduction

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are released to pits located in the Conasauga shale formation. Low level liquid wastes are discharged, after preliminary treatment, to the surface streams.

Air that may become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by means of filters, scrubbers, and/or precipitators.

This report presents data on the environmental levels of radioactivity for the Oak Ridge Area and compares the data with established maximum permissible concentrations.

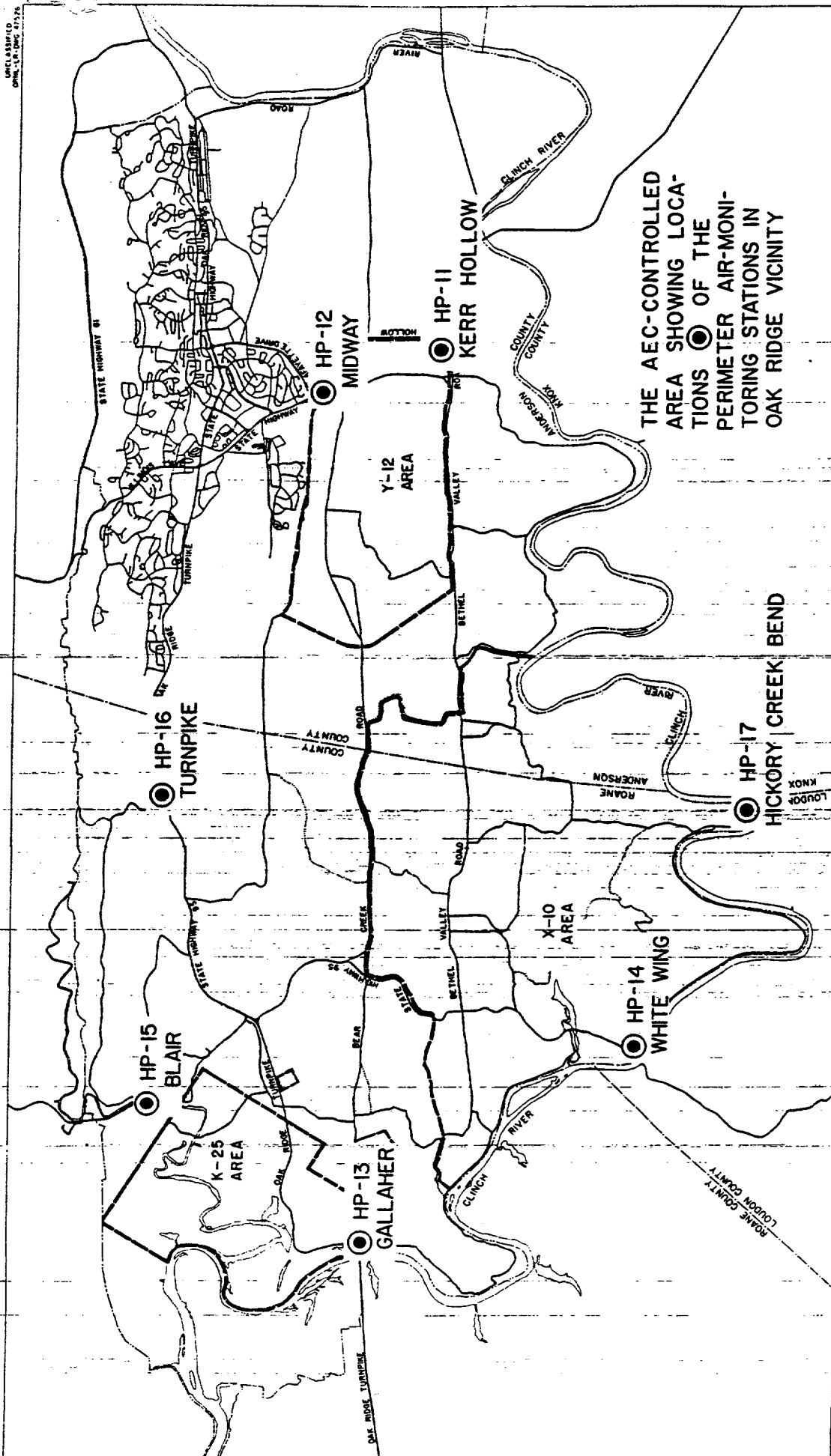
Air Monitoring

Atmospheric contamination by long-lived fission products and fall-out occurring in the general environment of East Tennessee are monitored by two systems of monitoring stations. One system consists of seven stations which encircle the plant areas (Fig. 1) and provides data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of eight stations encircling the Oak Ridge Area at distances of from 12 to 120 miles (Fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Sampling is carried out by passing air continuously through a filter paper. The filter paper will collect those particulates considered to be respirable. Data collected are accumulated and tabulated in average $\mu\text{c/cc}$ of air sampled.

Atmospheric contamination by uranium is determined by taking periodic air samples at seven locations on a two-mile radius and at seven locations on a five-mile radius from the Oak Ridge Gaseous Diffusion Plant (Fig. 3).

Water Monitoring

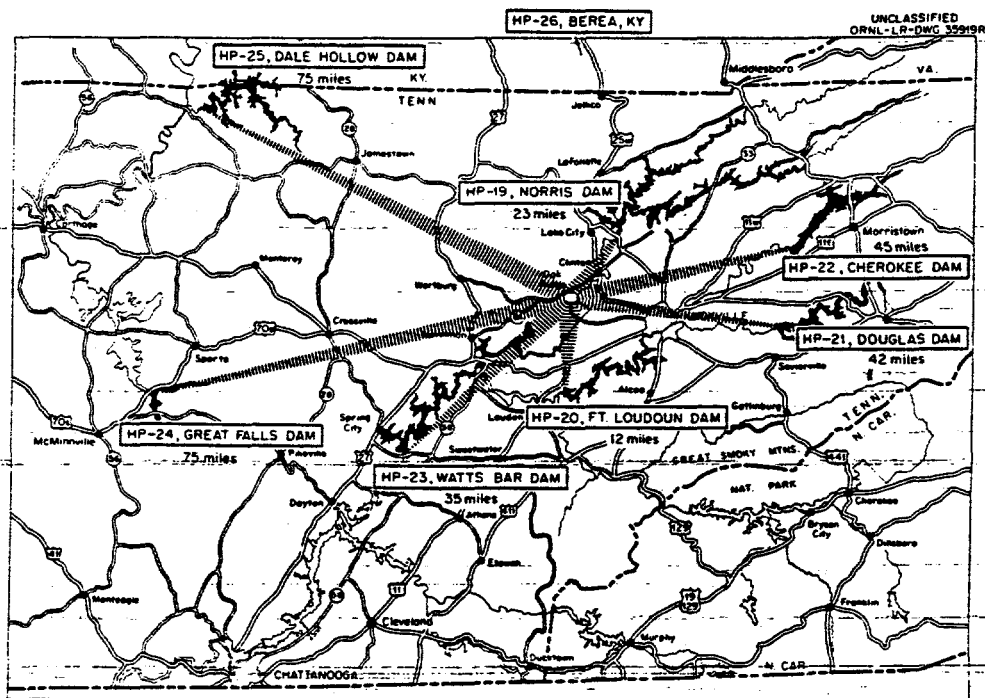
Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, into the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply



THE AEC-CONTROLLED
AREA SHOWING LOCA-
TIONS OF THE
PERIMETER AIR-MONI-
TORING STATIONS IN
OAK RIDGE VICINITY

STATION SITES FOR PERIMETER AIR MONITORING SYSTEM

Figure 1



STATION SITES FOR REMOTE AIR MONITORING SYSTEM

Figure 2

with the maximum permissible levels for populations in the neighborhood of a controlled area as recommended by the National Committee on Radiation Protection (NCRP). The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 4 and 5. Samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously by the United States Geological Survey to obtain dilution factors for calculating the probable concentrations of wastes in the river.

Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters.

The fraction of the total beta activity comprised by each isotope is determined from analysis of long-lived radionuclides contained in the effluent and a weighted average maximum permissible concentration for water, $(MPC)_w$, for the mixture of radionuclides is calculated on the basis of the isotopic distribution using the MPC values of each isotope as recommended by the NCRP. The average concentrations of gross beta activity in the Clinch River are compared to the calculated $(MPC)_w$ values.

The concentration of uranium is compared with the specific $(MPC)_w$ value for uranium.

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge Area. Measurements are taken with a Geiger-Muller tube at a distance of three feet aboveground and the results are tabulated in terms of mr/hr.

Discussion of Data

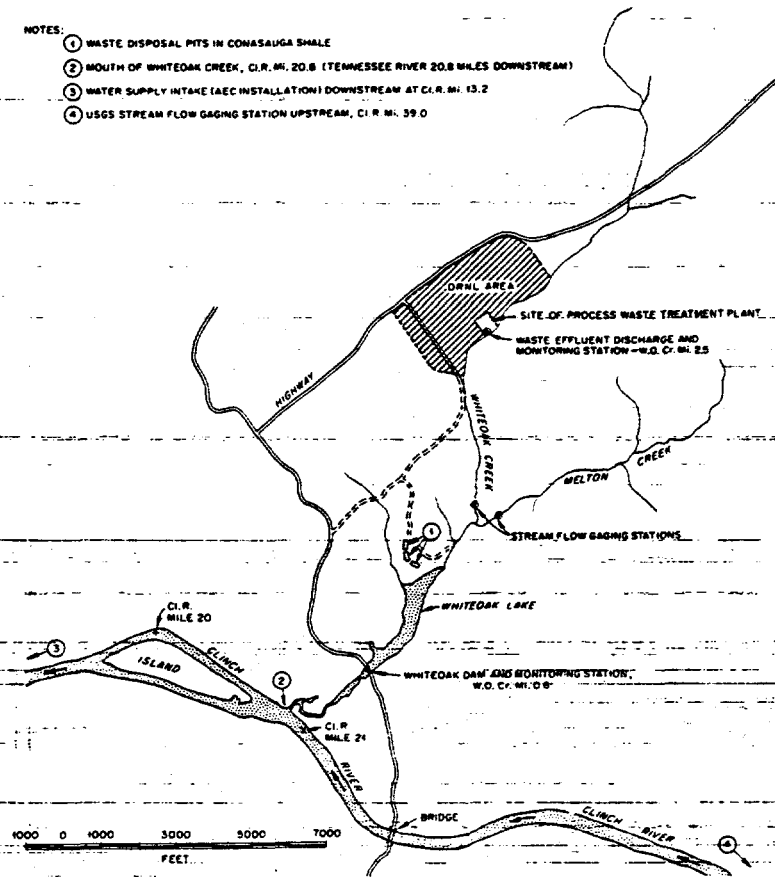
Data on the environmental levels of radioactivity for the fourth quarter of 1960 in the Oak Ridge and surrounding areas are presented in Table I through Table VI.

The air contamination level for gross β activity as shown by the continuous air monitoring filter data for both the immediate and remote environs of the plants was 0.05% of the maximum permissible concentration for populations in the neighborhood of a controlled area. The levels measured during this period were not significantly different from those measured in other areas of the United States and reported by the U. S. Public Health Service Radiation Surveillance Network.

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NOTES:

- ① WASTE DISPOSAL PITS IN CONASAUGA SHALE
- ② MOUTH OF WHITEOAK CREEK, C.I.R. MI. 20.8 (TENNESSEE RIVER 20.8 MILES DOWNSTREAM)
- ③ WATER SUPPLY INTAKE (AEC INSTALLATION) DOWNSTREAM AT C.I.R. MI. 13.2
- ④ USGS STREAM FLOW GAGING STATION UPSTREAM, C.I.R. MI. 39.0



Location Sketch Map
ORNL Area Surface Drainage

Figure 4

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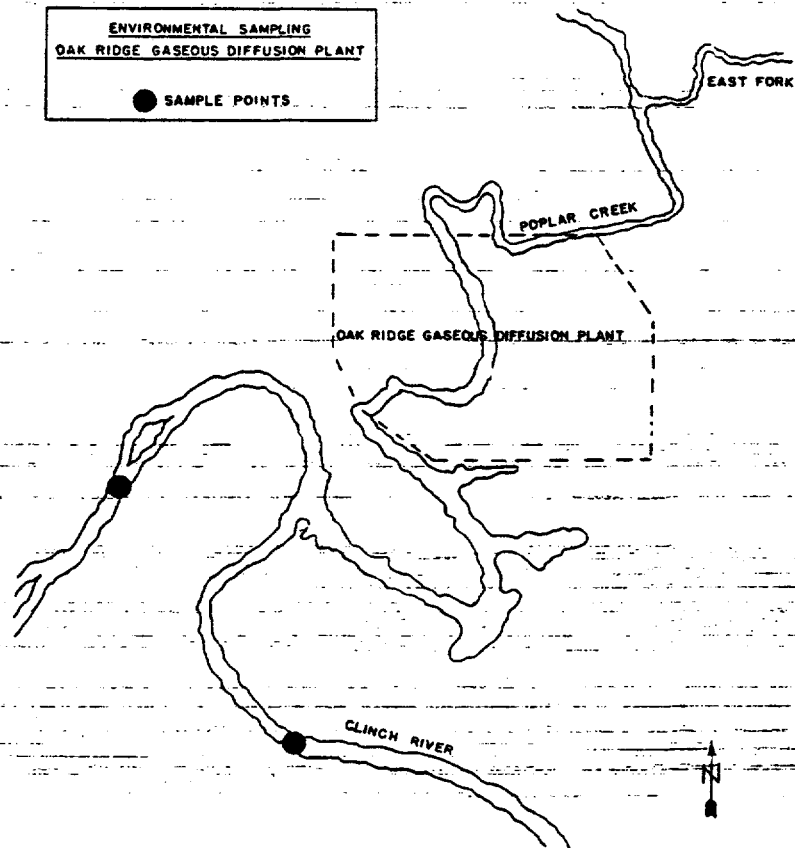


Figure 5

The average air-borne alpha activity in the environs of the ORGDP as determined from the results of ten-minute spot samples at locations two and five miles from the plant was slightly above the normally low level. A single period of increased activity which occurred early in November was coincident with a pilot stage run being made with highly enriched uranium materials and was largely responsible for this increase. Following completion of the short run, background values were again rapidly re-established; modification of the involved process is being studied. Of the 427 eight-hour continuous samples obtained in those plant operations areas where stack or vent discharge of uranium materials is possible, less than 1% were above the maximum permissible concentration for occupational exposure and the average was only a small fraction of this concentration.

The calculated average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most waste materials, and at Mile 4.5, near Kingston, Tennessee, were 7.0×10^{-7} $\mu\text{c/cc}$ and 6.0×10^{-7} $\mu\text{c/cc}$ respectively. These values are 22% and 17% of the weighted average maximum permissible concentration as recommended by the National Committee on Radiation Protection. The rise in concentration of radioactivity in the Clinch River during this quarter reflects an increase in the quantity of radioactive materials discharged. The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 1.4×10^{-11} $\mu\text{c/cc}$ which is 0.0004% of the weighted average (MPC)_w value.

The average activity of natural uranium materials in the Clinch River, reflecting the effects of all of the Oak Ridge Plants, was only 0.01% of the (MPC)_w for uranium.

External gamma radiation in the Oak Ridge Area averaged 0.015 mr/hr. This level is not significantly different from the average of the levels measured throughout the United States by the U. S. Public Health Service Radiation Surveillance Network.

Conclusion

From the data presented, it seems evident that the Oak Ridge Operations are contributing little to the air or ground contamination in the neighborhood of the area controlled by the Atomic Energy Commission.

Some radioactivity has been contributed to the Clinch River by the release of radioactive liquid wastes, but concentrations of radioactivity in the river are well below the maximum permissible concentration recommended by the NCRP for populations living in the vicinity of an atomic energy installation.

TABLE I

CONTINUOUS AIR MONITORING DATA

Long-Lived Fission Products

Fourth Quarter 1960

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{c/cc}$			% of (MPC) ^a *
			Maximum	Minimum	Average	
<u>Perimeter Stations</u>						
HP-11	Kerr Hollow Gate	13	0.96	0.04	0.37	0.04
HP-12	Midway Gate	13	1.80	0.20	0.50	0.05
HP-13	Gallaher Gate	13	0.72	0.24	0.50	0.05
HP-14	White Wing Gate	13	0.72	0.20	0.46	0.05
HP-15	Blair Gate	13	0.89	0.24	0.52	0.05
HP-16	Turnpike Gate	13	1.09	0.12	0.46	0.05
HP-17	Hickory Creek Bend	13	1.06	0.15	0.41	0.04
Average					0.46	0.05
<u>Remote Stations</u>						
HP-19	Norris Dam	13	2.66	0.39	0.80	0.08
HP-20	Loudoun Dam	13	0.81	0.25	0.49	0.05
HP-21	Douglas Dam	13	0.99	0.12	0.46	0.05
HP-22	Cherokee Dam	13	0.75	0.14	0.41	0.04
HP-23	Watts Bar Dam	13	0.78	0.27	0.52	0.05
HP-24	Great Falls Dam	13	0.62	0.31	0.49	0.05
HP-25	Dale Hollow Dam	12	0.69	0.18	0.38	0.04
HP-26	Berea, Kentucky	12	0.63	0.12	0.34	0.03
Average					0.49	0.05

* (MPC)^a is taken to be 10^{-10} $\mu\text{c/cc}$ as recommended in NBS Handbook 69, Table 4, p. 94.

TABLE II

OAK RIDGE GASEOUS DIFFUSION PLANT AIR MONITORING DATA

URANIUM

Fourth Quarter 1960

Distance from Center of Plant	Type of Analyses	No. of Samples	Units of 10^{-13} $\mu\text{c/cc}$						(MPC)a	% (MPC)a
			Direction from Plant			Average				
			North	East	South					
								West		
2-Mile Radius*	Uranium Concentration	42	1.16	0.81	1.69	0.0	1.11	20	5.6	
2-Mile Radius**	"	16	270	312	39	180	188	7.0		
5-Mile Radius*	"	40	7.10	2.54	1.62	2.6	3.06	20	15.3	
5-Mile Radius**	"	16	169	93	49	169	110			

* Reflects normal levels existing over most of quarter.

** Reflects increased levels existing for a single sample period. See discussion on Page 8, paragraph 1.

current
FRC recommended
for control.

TABLE IV

AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
IN THE CLINCH RIVER

Fourth Quarter 1960

Location	Units of 10^{-8} $\mu\text{C}/\text{cc}$						(MPC) _w ^a	% of MPC
	Sr ⁹⁰	Ce ¹⁴⁴	Cs ¹³⁷	Ru ¹⁰³⁻¹⁰⁶	Co ⁶⁰	Average Gross Beta Activity		
Mi. 37.5	.05	.04	*	*	*	0.14	27	0.5
Mi. 20.8 ^b	0.71	0.16	0.39	$\frac{28 \pm}{40}$	0.86	70	320	22
Mi. 4.5	1.31	0.11	0.14	$\frac{40}{40}$	0.81	60	345	17

^a Weighted average (MPC)_w calculated for the mixture using (MPC)_w values for specific radionuclides recommended in the NBS Handbook 69.

^b Values given for this location are calculated values based on levels of waste released and the dilution afforded by the river.

* None detected.

TABLE V

URANIUM CONCENTRATION IN THE CLINCH RIVER

Fourth Quarter 1960

Sampling Point	Type of Analyses Made	No. of Samples	Units of 10^{-8}			$\mu\text{c/cc}$ Average	(MPC) ^w	% (MPC) ^w
			Maximum	Minimum				
Upstream from ORGDP	Uranium Concentration	7	0.28	< 0.07		0.14	2000	< 0.01
Downstream from ORGDP	"	7	1.5	0.07		0.27	2000	0.01

Normal Sampling Frequency: Continuous, composited over one week.

TABLE VI

EXTERNAL GAMMA RADIATION LEVELS

mr/hr

Fourth Quarter 1960

Station Number	Location	October	November	December	Average
1	Solway Gate	.012	.016	.012	.013
2	Y-12 East Portal	.012	.014	.013	.013
3	Newcomb Road Oak Ridge, Tenn.	.015	.013	.013	.014
4	Gallaher Gate	.020	.015	.016	.017
5	White Wing Gate	.018	.015	.015	.016
Average					.015

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